REMARKS

Claims 8-18 are currently pending in the application. Claims 1-7 have been canceled. New claims 8-18 have been added. Applicant respectfully submits that no new matter has been added. Applicant respectfully requests reconsideration of the application in view of the foregoing amendments and the following remarks.

Applicant respectfully submits that new claims 8-18 have been added per suggestion by the Examiner. More specifically, in an Examiner interview held on September 20, 2006, the Examiner suggested that new claims directed to a method for constructing a scalable computer system utilizing small world network principles must be presented for examination.

Claims 1-5 and 7 stand rejected under rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,602,839 to Annapareddy et al. ("Annapareddy") in view of "Collective dynamics of 'small world' networks", to Watts et al. ("Watts"). Claims 6 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Annapareddy in view Watts and further in view of U.S. Patent No. 5,859,975 to Brewer et al. ("Brewer"). Claims 1-7 have been canceled, thus rendering the rejections thereof moot.

New claim 8 relates to a method for constructing a scalable computer system. Applicant respectfully submits that the cited combination of Annapareddy and Watts fails to teach, suggest, or render obvious at least one of the distinguishing features of independent claim 8, namely, interconnecting a plurality of computing nodes to form a plurality of node clusters, providing a plurality of cross-links between the node clusters, and directly connecting the plurality of node clusters via the plurality of cross-links such that the system comprises a small-world network. In addition, Applicant respectfully submits that the cited references fail to disclose wherein the small-world network comprises a substantially higher clustering coefficient of nodes in comparison with a corresponding randomly-connected network in combination with a substantially lower characteristic path length between the nodes in comparison with a corresponding regularly-connected network.

Applicant respectfully submits that historically there have been two main approaches for interconnecting large number of processing nodes. First, a large number of direct connections may be provided between nodes, resulting in a low mean path length between the nodes. This approach results in a substantially quadratic increase in the number of interconnections as the number of nodes are scaled. Second, regular lattice or ring type structures employing mainly local connections between nodes enable a manageable scaling of interconnections as the number of nodes increase. However, this approach requires messages to be routed along multi-hop paths. The path length increases approximately linearly with the size of the system. In the latter approach, propagation and buffering delays ultimately limit the system performance, such that further increase in the number of processing nodes fails to increase in processing capacity.

Applicant respectfully submits that, in accordance with the prior art, the trade off between interconnect complexity and path length exemplified by these two extremes is unavoidable. Therefore, it is not possible to achieve a low mean path length in combination with a low interconnect complexity in a large scale system. As a result, the realization that the small world principle as claimed provides a methodology for designing and constructing massively scaleable systems having precisely this advantage is counter-intuitive in the face of the pre-existing beliefs, and represents a genuine breakthrough in the art.

Annapareddy is cited by the Office Action as disclosing a system comprising a plurality of computing nodes; however, the Office Action concedes that Annapareddy is silent regarding "... selecting the cross-links such that the system comprises a small world network ..." See Office Action, p. 2. Watts has been cited by the Examiner as supplying this deficiency of Annapareddy. Given the above, the Office Action suggests that it would have been an advantageous modification to "...the system disclosed by Annapareddy since it would have significantly reduced the average path length, resulting in reduced latency and more efficient routing on the network, since the average number of hops required to reach a distant node would be decreased."

Applicant first respectfully submits that there is no motivation to combine Annapareddy and Watts. Annapareddy discloses a multinode communication or multiprocessor network in which messages are communicated from one node to another using an adaptive and

dynamic routing scheme. The routing scheme includes two-level multi-path routing tables at each node to ensure efficient delivery of the messages. The routing scheme also includes a deflection counter in each message header to avoid endless rerouting of messages and an exponential back off and retry policy to avoid deadlocks. The network depicted in Figure 2 of Annapareddy is a substantially regularly-connected network having a high degree of interconnection and does not exhibit any of the characteristics of a small-world network.

Watts discloses an analysis and a mathematical description of the properties of "small world" networks. Watts discloses that the small world principle can be embodied in a variety of biological, technological, and social networks. Watts further discloses techniques for analyzing existing networks in order to assess the extent to which the existing networks embody the small world principle.

Applicant respectfully submits that the network taught by Annapareddy utilizes an adaptive and dynamic routing scheme which is applicable to prior art multi-processor networks. Annapareddy fails to disclose using novel physical network topologies such as, for example, the small-world network topology to overcome problems of latency and efficient routing. Annapareddy discloses a fully connected network having a substantially one-to-one connectivity which <u>cannot</u> be scaled. More specifically, combining the small world network design with the network design taught by Annapareddy would render the adaptive and dynamic scheme of Annapareddy unnecessary. Therefore, there would be no motivation to utilize the small world principle of Watts with a multinode communication or multiprocessor network in which messages are communicated from one node to another using an adaptive and dynamic routing scheme as disclosed in Annapareddy.

In addition, Watts fails to disclose or suggest directly connecting the plurality of node clusters via a plurality of cross-links such that the system comprises a small-world network and wherein the small-world network comprises a substantially higher clustering coefficient of nodes in comparison with a corresponding randomly-connected network in combination with a substantially lower characteristic path length between the nodes in comparison with a corresponding regularly-connected network as claimed.

Given the above, Applicant respectfully submits that there is no motivation to combine the teachings of Annapareddy and Watts as suggested by the Office Action. Indeed, even if the teachings of Annapareddy and Watts were somehow combined as suggested by the Office Action, Applicant respectfully submits that it is not apparent that the introduction of "a few random links" into the prior art multi-processor network of Annapareddy would result in the conversion of the prior art multi-processor network of Annapareddy into a small world network design as claimed.

Neither Annapareddy nor Watts, nor any combination thereof, teaches, suggests or renders obvious any method of constructing a scalable computer system in accordance with new claim 8. Applicant further notes that, in the new reference, which was discussed during the Examiner's interview, "It's a small world", June 1998, Nature, Vol 393, pp 409-410, to James J Collins and Carson C Chow ("Collins"), made of record by the Examiner in the Office Action dated 7 August 2006 and which was published simultaneously with Watts, it is acknowledged that "strategies for determining and achieving optimal small-world connectivity remain to be developed" (final sentence). Applicant respectfully submits that the present invention, as claimed, for the first time provides such a strategy, and is novel and non-obvious in view of the cited art.

For all the foregoing reasons, Applicant respectfully submits that independent claim 8 distinguishes over the cited combination of Annapareddy and Watts and is in condition for allowance.

Dependent claims 9-13 depend from and further restrict independent claim 8 in a patentable sense. Applicant respectfully submits that, for at least the reasons set forth above with respect to the rejection of independent claim 8, dependent claims 9-13 distinguish over the cited combination of Annapareddy and Watts and are in condition for allowance.

New claim 14 relates to a method for constructing a large scale computer system. Applicant respectfully submits that the cited combination of Annapareddy and Watts fails to teach, suggest, or render obvious at least one of the distinguishing features of independent claim 14, namely, forming clusters of fully interconnected nodes by arranging a plurality of nodes in a network with neighboring sets of nodes, wherein each node of the plurality of nodes includes a

plurality of interconnected processors, providing a plurality of cross-links between selected nodes of different clusters, and directly connecting the selected nodes via the plurality of cross-links such that the system comprises a small-world network. In addition, Applicant respectfully submits that the cited references fail to disclose wherein the small-world network comprises a substantially higher clustering coefficient of nodes in comparison with a corresponding randomly-connected network in combination with a substantially lower characteristic path length between the nodes in comparison with a corresponding regularly-connected network. Additionally, Applicant submits that claim 14 patentably distinguishes over Annapareddy and Watts for similar reasons to those discussed above with respect to independent claim 8. Applicant respectfully submits that independent claim 14 distinguishes over the cited combination of Annapareddy and Watts and is in condition for allowance.

Dependent claims 15-18 depend from and further restrict independent claim 14 in a patentable sense. Applicant respectfully submits that, for at least the reasons set forth above with respect to the rejection of independent claim 14, dependent claims 15-18 distinguish over the cited combination of Annapareddy and Watts and are in condition for allowance.

In view of the above amendment, Applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

By ______________

Shoaib A. Mithani
Registration No.: L0067
JENKENS & GILCHRIST, A PROFESSIONAL CORPORATION
1445 Ross Avenue, Suite 3700
Dallas, Texas 75202
(214) 855-4500
Attorneys For Applicant